S-75M3 Volkhov (SA-2E Guideline)
SAMSIM Manual Supplement

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V.1 – 25 May 2012

Original photo description:

“This dangerous weapon system becomes reliable only in the hands of highly qualified crew”
(People’s Republic of Poland propaganda, 1985)

MOTTO:

One of the main purpose of this simulator, to teach the users of the **capabilities, and limitations** of these elderly (and mystic) SAM systems. They are like a "samurai sword" in modern warfare, pretty obsolete and old fashioned weapons, but if you do not take them seriously, they can be still deadly.

I. The unchartered switches:

1 – microphones on-off (not simulated)

2 – connect with call destination selected by (3) (not simulated)

3 – select call destination (not simulated)

4 – RPK (Radio transmiter for missile commands)
Battle value: Two positions – left: „Dummy load"; Right „Antenna". It is used to transmit fake launch signals to enemy formations, forcing them to break the battle formation and drop it's loads.The RPK system is continuously calculating and creating the missile guidance commands, even when they are not launched.Those signals could be sent to the dummy load, or emitted by the P16 antenna.
With this switch, you can select between dummy load (EKV) or the P16 (ANT).When missile is launched, this switch is overruled and the commands are emitted via the P16. If the P16 is selected (manually or automatically), it is indicated by the green lamp.At the Volkhov, if the system is in BR and 75 km mode, the RPK signals are automatically sent to the P16 to frighten the enemy. In all other modes, you may use it manually at will.
RPK - EKV/ANT switch should not be used in real combat, as the BR/75 km mode has the same effect.

5 – H<1, "Height less than 1 km" mode (not simulated)
Battle value (real life only): When close to the ground, radar reflection causes echo from the earth, which results in a „twin mark", on epsilon screen. In such case, one from the right of the epsilon screen (higher from the ground) should be further tracked.

6 – H>18, uses modified guidance algorithm for guiding missiles against targets above altitude of 18 km. Has negligible effect in the sim.

7 – Karat (target tracking TV camera) optics dehumidifying on/off (not simulated)..

8 - remote switch-on controls, for the PV/AV/UV cabin. During maintenance, they could be switched on independently (not simulated).

9 – h1 and h2 scale switch (h1 and h2, located respectively in the left and right)
While the missile is flying, you can see the K1, K2 commands transmitted by the SNR, by selecting the KI, KII, KIII (for the three missile channel) between the instruments, above the button **9**.
If you select hI, hII, hIII you can see the calculated (not real!) miss distance (for the three missile channel), where the left instrument is for elevation, the right is for azimuth (one small tick is 40m, max indicated miss is 2000m). If you press the button **9** between the instruments, it will add 10x magnification, so one small tick is 4m, max indicated miss is 200.

10 ~ 14, 17, 18 - used during system warm-up battle readiness test (FK). Basically you can launch an electronic target with these.

14 - launch of an electronic target (used during FK to zero boresight and guidance commands) (not simulated)

15 – control light for K3 command (blinks when the signal K3, used either (1) to detonate the missile, or (2) when transmitted first time – arms radio proximity fuse, and second time – determines the missile path when target missed (missile passes range boresight line without detonating) (I can remember broader info somewhere)
Battle value: none. Observe for fun.

16 – control light for K4 command (used to update settings of radio proximity fuse in flight but prior to arming)
Battle value: none. Observe for fun.
How it works: the radio proxy fuse can detect the target obliquely, starting from either 70 degrees or 77 degrees deviation from the missile axis. The warhead can direct its fragments either +5 or -5 degrees perpendicular to the missile axis. The real-life effect is that the missile explodes not when it is closing to the target, but when *is passing* it. It guarantees that the warhead explodes at the minimum distance the missile *has ever been* to the target.
With the K4 command, the SNR signals the missile of the target-missile approach speed, and selects the proxy receiver antenna, and warhead direction.

Approach speed	Warhead detonation cone	Radio fuse detection cone
<670 m/s	+5 deg	77 deg with USU, 70 deg without USU
670-950 m/s	+5 deg	70 deg
950-1230 m/s	-5 deg	77 deg
>1230 m/s	-5 deg	70 deg

Example: when aiming at a high-speed closing target (target and missile passing each other *very fast*), K4 adjusts missile so that radio fuse detects the target a little bit *earlier* and warhead in turn explodes a little bit *backwards*. If such setting were not employed, there would be high chance that explosion occurs behind the target.

17 - see above

18 - see above

19 - missile channel display selector (channel 1/2/3/all) (not simulated).

20 – „Rab-ot-VM” – arming radio fuse 11 sec. after launch
How it works: Missile should know when to arm its radio proximity fuse. This is the crucial point. If it is not armed, than it will fly beside the target, and will not explode.
Usually the radio fuse is armed by the K3 command. The moment of sending this command is depending on the distance of the target (it should be on about 300 m distance before pre-calculated point of impact). The reason to arm radio fuse 300 m before the boresight is that 300 m is considered a warhead’s effective hit radius. If target attempts to jam radio fuse (that means, to prematurely detonate the missile, because radio fuse detonates the missile if it receives a signal on its working frequency), the SNR allows him to do it only in the distance that he would cause explosion resulting in a hit.
In some conditions (active jamming) it is impossible to determine distance to the target. This is the option which allows to arm the radio fuse. It should be set before launch. The shortcoming is the possibility of premature detonation due to chaffs/ground clutters (likely under B-52 formations in Linebacker II scenarios) and active jamming on radio fuse, especially on older type of missiles (not simulated so far).
There is two method in this case. One is the I87V, when you guess (or roughly know, e.g. from P-18) the target range, and the missile in result will be armed, on average, a few km before the range boresight.
The other advanced method is this Rab-ot-VM, <u>where you arm it right after launch</u>, by flipping switch **20** up. The Rab-ot-VM (“*rabota ot vremia*”) means “work by clock/time”. After the launch, a clock is started in the missile, and after 11 seconds (at approx 7 km from the launcher), it arms the radio proximity fuse.
The catch is that if the enemy is jamming the radio proximity fuse frequency (unlikely) or laying chaff (likely), then they can pop it up well before the target.
***Battle value*:** (1) Use only in connection with T/T as the only guidance method independent from exact distance determination. (2) Use if you are not sure about distance to the target, but sure enough it is in your kill envelope. Use I87V as your first-instance aid, and consider Rab-ot-VM only next. (3) Rab-ot-VM is of some use when shooting at low-altitude jamming targets. A “chaff corridor”, which detonates your missiles before the target, is conceivable only for high-altitude targets. In such case, do not forget to switch radio fuse 100-m sensitivity on.

21 – KRUG (all-around) – SEKT (sector) target acquisition switch. Determines the pattern the SNR follows after switching the scanning on (**22**)
***Battle value*:** Independent target acquisition method, dating back to early times when SNR was the battery’s only radar. Feature became outdated when meter-wavelength acquisition radars (P-12 / P-18), giving not so detailed picture but virtually immune to anti-radiation missiles, were assigned to batteries as standard. After anti-radiation missiles were introduced, the decision to seek the target with SNR without any closer idea where to seek has been equal to suicide.

22 – POISK (search) - scanning on, using method (21)

23 – STOP - scanning with method (21) off

24 – scanning control light, lights up when (22) is selected, switched off with (23)

25 – I-II-III-CU position of this switch has result on both circular indicators, showing where launchers are directed (red arrow). When switched, launchers associated with missile channel 1-2-3-CU are shown, respectively. If switched to the rightmost "CU" setting, it shows the IADS-provided direction.

26 – changing for wartime frequency (Beta – Epsilon)
Battle value: when switched, changes the emission frequency for Epsilon (left) and Beta (right) antennas for wartime frequency. It was strictly prohibited (firing squad, *Tovarish*!) to go on air in peacetime using this frequency, as it was intended to provide a little extra surprise to enemy during war. In case of strong active jamming, changing the frequency could help avoiding jamming for one critical while. Nowadays, when automatic jamming devices adjust their frequency within fraction of second, of LIMITED value. Not simulated anyway.

27 - Karat target tracking TV on (not simulated).

28 - ??

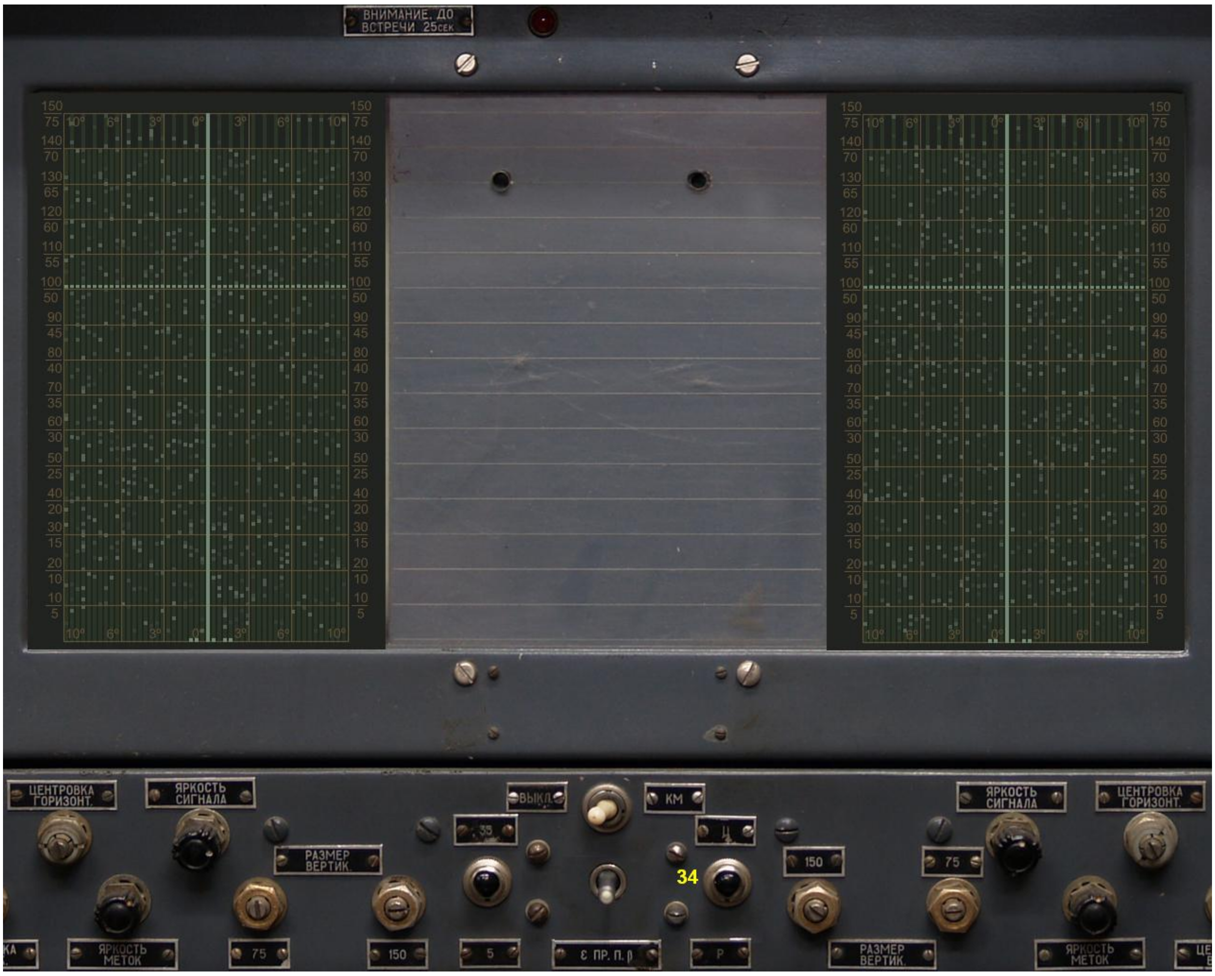
29 – constant impulse repetition rate (default is alternating)
***Battle value*:** In case of tracking low altitude targets in 75 km mode, some clutters could appear on the screen, being actually from over this range. If we switch on SDC, we find out, that it could filter clutter till 75 km, but all clutter, that is beyond 75 km are overlaid on our scopes. If we now turn off the constant impulse repetition rate, we can filter all clutter, from the screen (over 75 km too), but we cannot discriminate targets over 75 km

30 – Rab na Fo/2 (impulse repetition rate is halved)
***Battle value*:** This is another way to overcome strong passive (ground) clutters. While guiding a missile, it is not recommended to switch the range mode from 75 km to 150 km.(switching from 150 km to 75 km is ok). In case when we are guiding a missile, and we are in 75 km range mode, and would like to go to 35 km mode (*35 km is one method to overcome strong passive clutter beyond 75 km. The same amount of clutter is visible in both cases (150 km and 75 km modes).The difference is that in 75 km mode, a clutter at 100km is overlid as a clutter „at 25 km", so the SDC cannot filter it over 75 km*), we do the following:
(1) switch fo/2, leaving the range mode selector in 75 km mode.
(2) switch 35 km at the I32V panel. 35 km can only be switched from the 150 km mode (or from 75 km with fo/2).If you are in 75 km and you select 35 km, nothing should happen.

31 - ??

32 – wind compensation knobs: fine tuning for SDC

33 - ??



34 – target / missile channel display selector (jamming check):
Upper position (C) – displays only target channel. Lower position (R) – displays only missiles channel.– designed to make sure if enemy jammed missile channel. In fact such jamming had no effect versus late Volkhov (and Dvina) missiles, so simulating this feature would be pointless.
Battle value: none. In the sim, any jamming is done at target channel. Observe for fun.

Missile channel jamming story:
Such jamming did have effect versus early Dvina V-750VK missiles in Vietnam. Between December 1967 and February 1968, literally hundreds of Vietnamese missiles went out of control right after launch. SNRs were unable to locate their missiles as their relatively weak transponder (transmitters of back-facing reply signal from the missile towards SNR which made them visible) signal was suppressed by very effective USAF's QRC-160-8 jamming pods. Soviets reacted quickly after an example QRC-160-8 was salvaged from a downed F-105 in February 1968 - solution was to double the missile marker number of pieces, and increase its output with the introduction of the V-750VM/VMK missile type. Since then, missile channel jamming was ineffective.
Interestingly, the US TAC HQ learned this, and the Weasels/F-4's were not jamming this channel for several years. However, this info was lost in the USAF organization, so SAC HQ had no knowledge of it. As late as during Linebacker II in 1972, all B-52s were still instructed to jam the missile downlink signal channel, using up - for no effect – their valuable jammers which could otherwise had been tuned to deal with SNR target tracking.

II. Some hints on tactics:

Receding target maximum speed:
It's 420m/s for Volkhov – just remember this value, don't waste your missiles.

Non-cooperating target recognition:
Chance of target recognition is very limited, however.... You can guess from target speed and maneuverability. One of hints is in the fact that jamming equipment against metric wavelength radar is pretty space-consuming. In short, only B-52, or specialized EW aircraft could jam it, fighters cannot. Metric wavelength radars are also not vulnerable to Anti Radiation Missiles, and could be used for observation on a 24 -hours basis without risks.
If you see strobes at your P-18 screen, it's either stand-off jammer or B-52. Refer to plotting board to have more certainty.

Max speed and overload capability of V-759 5Ya23 missile (depending on target altitude):
at 300m altitude, 785m/s (Mach2.6), 6~7g
at 10km altitude, 910m/s (Mach3), 7~9g
at 25km altitude, 1125m/s (Mach3.7), 3~3.3g
at 30km altitude, 1230m/s (Mach4), 2.1~2.4g

Max overload capability of various S-75M missiles:
V-755 20D (Guideline Mod.3) 6.5g
V-760 15D (Guideline Mod.4) 5.8g
V-759 5Ya23 (Guideline Mod.5) 9g
V-760V 5V29 (Guideline Mod.4) 6.5g

What is the maximum admissible missile flight deviation from the boresight (in degreess)?
With a subsonic target calculated impact point is closer to the target. It can be less than 4 degrees, depending on the Parameter. Supersonic target calculated impact point is further to the target. It can at some moment be more than 4 degreess, but the system limits the missile to lead the target max 4 degreess.
When the missile is flying at less than 4 degreess lead, than it is directly goes towards the calculated impact point.
When the missile is flying at 4 degreess, the calculated impact point is at probably more than 4 degreess, just the system limits its lead angle.

What is the principle of employing of the K guidance method?
This K guidance method is simply lead, just adding a Constant "K" into elevation, depending the distance of the missile to the range boresight.
If the missile - boresight distance is larger than 10km, it adds 1.2 degrees to the elevation boresight. From 10km, it gradually reduces this Constant to 0 degrees. (at 5km it is 0.6 degrees)
Battle value: if you want to add 0.6degrees elevation at the impact point, to compensate the missile overload capability limitation, than just move the range boresight to the calculated impact distance plus 5km.

How many missiles should you launch?
This results from math modeling and real practice. Definitely confirmed is that 3-missile salvo is the best and most succesful way to destroy a target (in fact, 1 missile was recommended only against spy balloons). Using 3 missiles is a "must" against (1) maneuverable targets, (2) jamming targets, (3) receding targets (fuse detects the tail of target, and fragments hits tail, so no important components are destroyed), (4) high parameter targets (against targets with maximum parameter - fragments hits with 0-15 degreess and often only "scratch" the target).
From SAMSIM experience: 2-missile salvo is enough in most cases. If you set explosion on K3, which is not so accurate, shoot 3 missiles. (Vietnamese preferred also to launch 2 instead of 3)

Switching the transmitter off in battle – when, and what then?

When tracking a target with Volkhov, and the transmission switched off, the APP still calculates point of impact. Besides, the Dvina/Volkhov is keeping the last good known delta angle (angular speed of the target) and delta range (radial speed of the target) – that's why green tracking lights are still burning even though you – and the SNR – cannot see the target at the moment. The system keeps the SNR rotation speed, staying AS. When the transmitter switched back, and the target has not made big turns, the system can reacquire it quickly, or can lose its track.

This assumption plays its role with target flying straight forward, with maneuvering target… well, *c'est la vie*!

In real life, it was really suggested to switch off illumination for short periods after launch to confuse enemy. The "25 sec" lamp on the "A" panel is illuminating to indicate that you need to switch illumination on because of terminal guidance phase. In short - this can be used against non-jamming targets this way: (1) target tracked, (2) missile is launched, (3) transmitter off, (4) wait till 25s lamp illuminates, (5) transmitter on until explosion.

El Dorado Canyon experiences:

(1) the explosion in (5) above can be as well from HARM hitting your SNR. As I've said, *c'est la vie!*

(2) you can launch the missile with transmitter off if you are sure that delta angle/range give good target position.

Example: SNR usage sequence during El Dorado Canyon:

(1) try to pre-set as much as you can from target coordinates from P-18 (targets that suddenly disappeared from the P-18's screen should be found on low altitudes) . Adjust other settings accordingly (guidance method, radio fuse) – being well prepared, only 'pusk' and 'transmitter' switches should remain.

(2) Transmitter on for NO LONGER THAN 3 SECONDS. Try to lock on beta and epsilon during that time. To release beta angle, turn off CU-II switch just before transmitter on (otherwise it will be slaved to P-18)

(3) Transmitter off and wait…

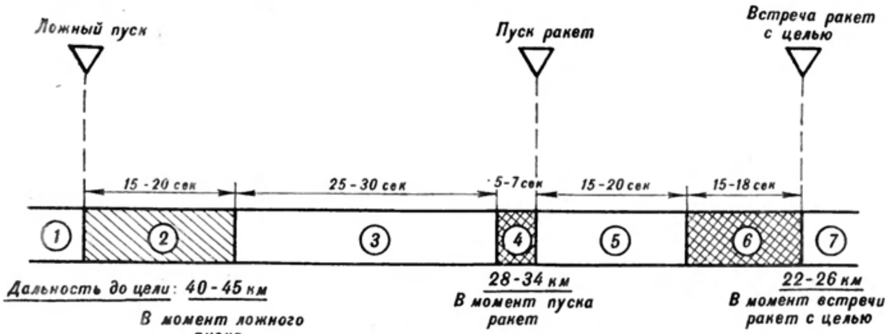
(4) Launch when range goes down to no more than 15 km. This will minimize missile flight time which means RPK on-the-air period. Remember that HARM can home on RPK signals too.

(5) Switch transmitter on when you find appropriate – I personally prefer some 10 sec. before missile hit.

This procedure gives SOME chance to keep SNR (incl. RPK) emission time below 20 sec. Survival, anyway, not guaranteed.

Using SNR in Shrike environment

The below diagram was produced by Soviet specialists on the basis of conclusions from SA-75M Dvina employment in Vietnam War against AGM-45 Shrike-equipped Wild Weasel aircraft.



1-2 – false launch (target at 40-45 km) – emitting RPK signals for 15-20 sec., causing enemy to launch Shrike

3 – RPK off for 25-30 sec. – allowing Shrike to hit the ground after unguided flight (after losing signal).

4 – transmitter on for 5-7 sec. (target at 28-34 km) fixing target position immediately before real launch. Transmitter off after launch.

5 – first 15-20 sec. of missile flight – transmitter off, RPK emitted.

6 – 15-18 sec. before expected impact – transmitter on. Target at 22-26 km at the moment of hit.

Рис. 3.25. Зависимость отклонения ПРС «Шрайк» от дальности перехода на эквивалент антенны

AGM-45 miss distance against distance in the moment of switching off SNR.

(horizontal – distance in km at the moment of switching SNR off, vertical – probable AGM-45 miss in km)

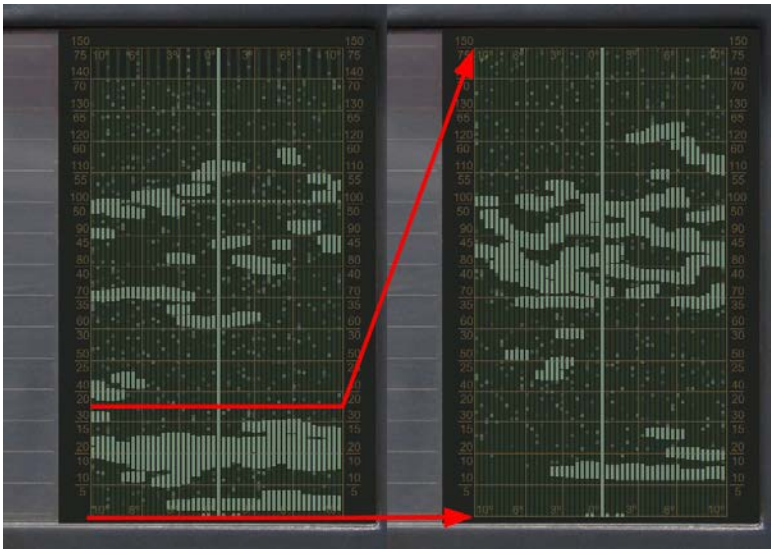
Do not try it against HARM. It can remember target position, homes on RPK signals too, and flies much faster than Shrike.

Using I87V + T/T – when and how?

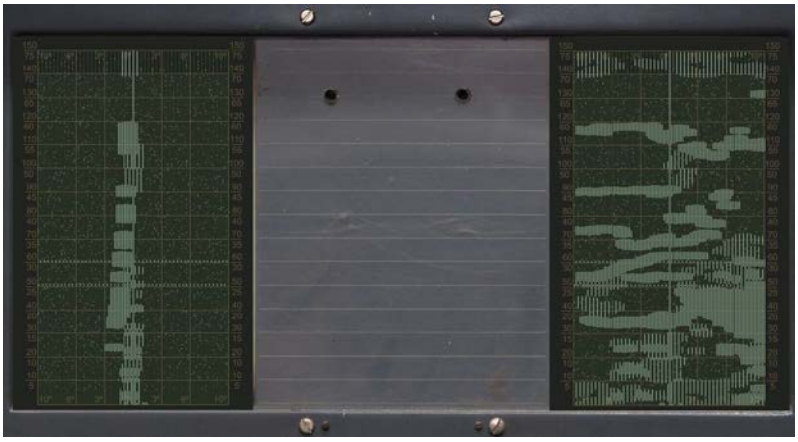
T/T method with Rab-ot-VM arming (just after launch, unchartered switch **20**) is good against jamming targets, unless... target is flying low, and the armed radio proxy fuse is confused by the signals from the ground.
Above Hanoi, the USAF had the nasty habit of laying chaff corridor under the jamming B-52s.
If you would launch with T/T Rab-ot-VM, then the missile would pop off when it reaches the chaff corridor.
This is when the I87V-T/T comes to play, as it calculates an approximate jamming target distance, so the proxy fuse is not armed, until flies above the chaff corridor.
You can modify input data in I87V (target distance/ altitude) at will, also during missile flight, as it does not change the intended flight path of the missile. It just changes the point where the radio proxy fuse arm. You are encouraged to update the I87V altitude data, as frequently as you got it from the plotting chart, or range, as displayed on your P-18.
Just important to know that the I87V-T/T works assuming that the target does not change its altitude! It is good against B-52s, but goes crazy against nimble fighters.

Overcoming strong passive clutter:

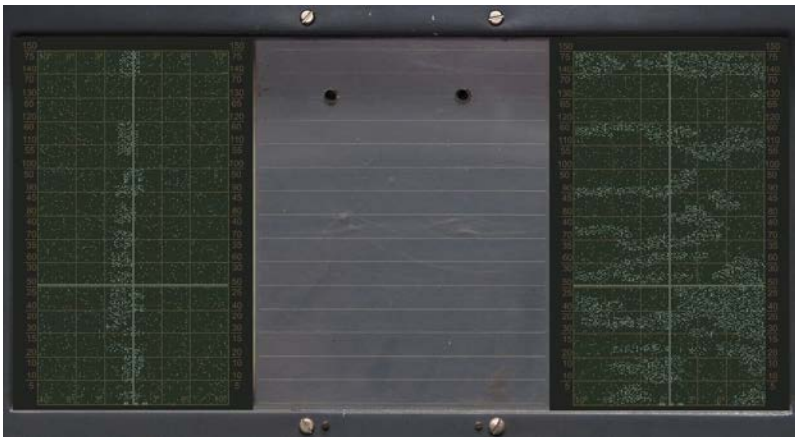
RAB.NA fo/2 (**switch 30**) - it is an extreme rarely used feature of the Volhov.
While guiding a missile, it is not recommended to switch the range mode from 75 km to 150 km. (switching from 150 km to 75 km is ok). In case, when we are guiding a missile, and we are in 75 km range mode, and would like to go to 35 km mode, we do the following...
1) switch fo/2, leaving the range mode selector in 75 km mode.
2)switch 35 km at the I32V panel (A screen).
35 km can only be switched from the 150 km mode (or from 75 km with fo/2).
35 km is one method to overcome strong passive clutter beyond 75 km. 35 km range mode is using the same 1044/1132 micro second emitted impulse repetition period, that is used by the 150 km range mode.The receiver in this case is open only for 233 micro second. To explain it in short, this is just the magnification of the first 35 km of the 150 km display.



Peremena chastoti (**switch 29**):
... so here we are, with lots of ground clutter.
We are in 75 km mode and some clutters are from over this range.

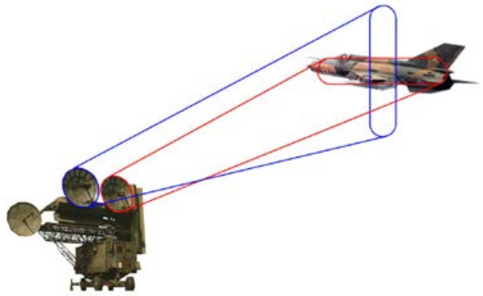


If we switch on SDC, we find out that while it can filter out clutter till 75 km, clutter that is beyond 75 km is still messing up our scopes. If we now turn on the constant impulse repetition rate (switch **29**), then we can filter all clutter from the screen (over 75 km too).

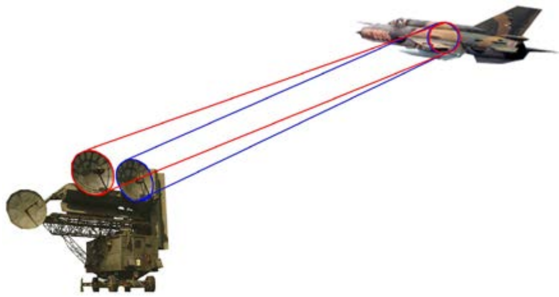


Why LORO protects you (slightly) better from Wild Weasel?

In Narrow Beam mode (Wide Beam is similar, just different antennas), the pencil beams are mechanically scanned.
Note that your beams travel forth and back through this “cross” in space, so anyone within this cross can receive it.



Using LORO, the scanning is stopped (or, more strictly, just your receivers, and not transmitters, scan the air), so only the tracked target can detect your SNR.



III. Other stuff

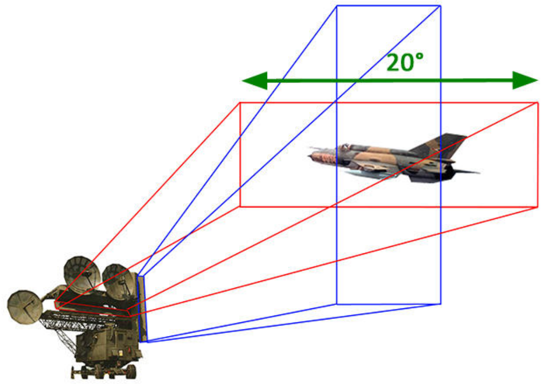
Why FCO display resolution appears to be “worse” in 150 km mode?

At 150 km range mode, the emitted electromagnetic impulse has to travel twice the distance, compared to 75 km mode, thus we could send out half of the amount compared to 75 km (half number of vertical lines).

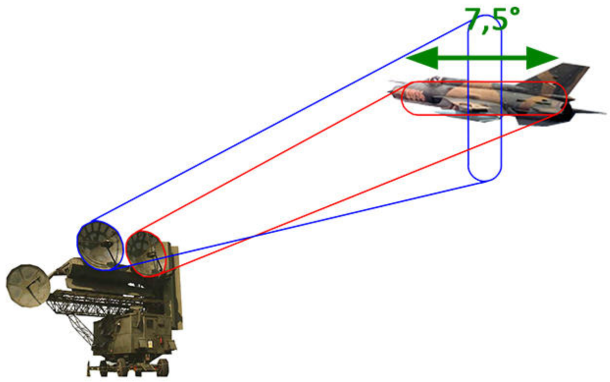
Why the target’s mark looks very wide in Narrow Beam mode?

Because the scan size is just 7.5°.

At the Wide Beam mode, the scan size is 20°, and it is displayed at the indicators of 20° horizontal resolution.



At the Narrow Beam mode, the scan size is only 7.5°, and it is displayed at the same indicators of 20° horizontal resolution



Target tracking modes:

SA-2/SA-3 both have:
- RS (manual target acquisition mode, Fire Control Officer);
- AS (manual target tracking mode, Elevation/Range/Azimuth Tracking Officer);
- AS-AP (automatic target tracking mode - by the system).

In the sim, we have only RS and AS-AP. Elevation/Range/Azimuth Tracking Officer is not simulated.

In real life, there are 3 ways of tracking the target:
1) FCO (the player) tracking in Epsilon/Beta/Range, his wheels are pulled out, towards him;
2) RS - manual tracking by Epsilon/Beta/Range tracker (done by AI), FCO wheels are pushed in (*you can hear it in the sim*), away from him;
3) AS - automatic tracking by the system (done by AI).

The green “tracking” lamps in FCO position (bottom of the Z screen) would go on as he pushed his wheels. That meant “the work” to be in manual trackers’ hands. In reality, the Manual Trackers should shout "Epsilon AS!", "Beta AS!", "Range AS!", when they switch from RS. There was no other way to inform the FCO as to whether RS or AS was being followed.

In the other words, the sim has AI Epsilon/Beta/Range tracker, so we only act as the FCO.
The FCO gives the control to the trackers by pushing his wheel, and RS (!!!) lamps will indicate it at the "Z" panel. The AI trackers will “decide” whether to track the target in AS or in RS.
Basically, if the target is visible, it will track it in AS. When the target disappears, the manual trackers change to RS, and keep the antenna moving try to find the target.

In the sim, if the target disappears (jamming off, High voltage or antenna off), the AI will try to maintain its track in RS. If it is in RS and, the target becomes visible again, it goes back to the AS code from the RS part of the program.

Let’s have a glance at real-life hardware:
Epsilon tracker RS-AS selector is on the Epsilon manual tracker position (see below picture). Note that the change of Epsilon speed is indicated, and not the Epsilon directly, as on the FCO’s display (this is why – and how - lockdown is implemented).

Manual Tracking is done by a trio of operators:

The elevation (Epsilon) manual angle tracker is sitting first.
He has only the epsilon screen, always in 5km magnification, and the Karat TV.

Then sits the range tracker. He can choose the elevation (Epsilon), or the azimuth (Beta) image on his screen.

The last one is the azimuth (Beta) tracker with a TV too.

They have to track the target <u>between two lines (and not with a single boresight</u>).
With their big wheels, they change the SNR rotation speed, rather than setting its direction.

You cannot do much with the wheels, if the missile is launched.
You can reacquire the target if it is lost, but the chance of hit is reduced.

Fuses/Warhead effectiveness:
- 65m is for pretty sure (~100%) kill
- 65~120m is high probability kill
- 300m is probable hit

The V-759 missile creates 29000 pieces of ~4g shrapnels. At the impact speeds, they are comparable to an M16 5,45 mm rifle bullet.
- If you have a 65m miss, than each square meters of the target will receive 2 pieces of M16 bullet (this is considered catastrophic kill).
- If you have a 120m miss, than each 2nd square meters of the target will receive an M16 bullet (this is considered a probable kill).
- If you have a 300m miss, than every 10 square meters of the target will receive an M16 bullet (this is considered the furthest distance where the missile has any effect).

Fuse sensitivity:
Against a MiG-17...
90% chance of detonation from radio proxy fuse, is at 73/116m (5E11/5H49)
50% chance of detonation from radio proxy fuse, is at 98/155m (5E11/5H49)
20% chance of detonation from radio proxy fuse, is at 110/175m (5E11/5H49)
Against a B-52, 20% chance of detonation from radio proxy fuse, is at 300/485m (5E11/5H49)
Against an F-4, 20% chance of detonation from radio proxy fuse, is at 170/270m (5E11/5H49)
Against an F-117, 20% chance of detonation from radio proxy fuse, is at 20/30m (5E11/5H49)

Possible radio fuse settings:
<u>At Q screen:</u>
ZEMLJA - ground - detonate missile by command (*separate switch*)
Fuse switch at the left:
STAN - arm the fuse 300m before the range boresight - detonate by radio proxy fuse
RAB PO ADA - against spy balloons - detonate missile by command, well before the target
ZAGRUB RV - reduce fuse sensitivity to avoid detonation by chaff and active jamming on radiofuse.
ZAGRUB RV USU - reduce fuse sensitivity to avoid detonation by chaff with USU missiles
NLC USU - gate fuse sensitivity to 100m against low flying targets
NC USU - used with nuclear missiles

<u>At Z screen:</u>
RAB OT VM - arm the fuse 11 sec. after launch - detonate by radio proxy fuse
RAB PO K3 - detonate missile by K3 command

<u>All those settings must be made BEFORE launch of the missile!</u>

What's exactly the GShV, and how it works?
When the KRUG was fielded in large numbers in the WARPACT, the US started the use of the Angular Jamming Technique.This is mostly developed against the monopulse radars (SA-4/SA-5/SA-6/SA-8/SA-10, ...) but it can also confuse older TWS radars (SA-2/SA-3).
Thus the GSh instrument was developed, to counter these kind of jamming utilizing a special TWS technique. For the **Volkhov**, it was called GSh**V**. For the **Neva**, it was called GSh**N**.
So far, this kind of jamming is not simulated in the SIM... and its technique is not discussed.

How was done the engagement via Karat-optical channel? *What were the procedures, what the operators saw, how was the scoope?*
The Elevation, and Azimuth tracking was manual. Guidance method is T/T. Radio proximity fuse was

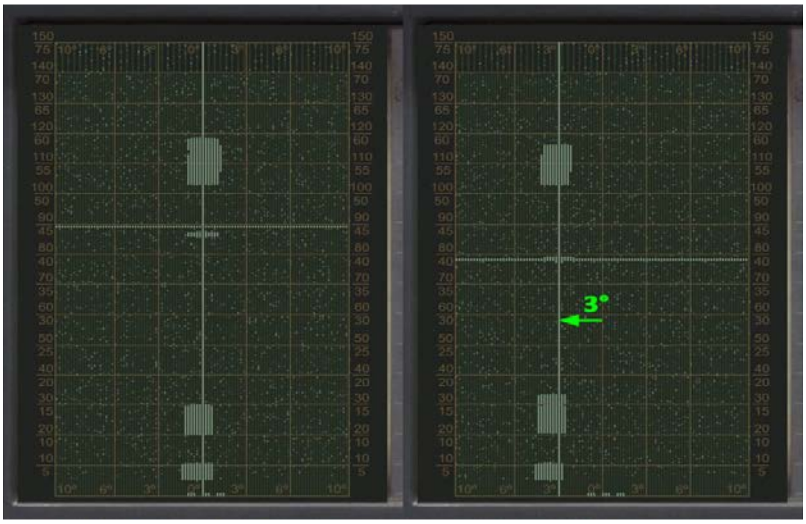
activated with Rab-ot-VM. method (or using radio-electronic range measurement, but then the whole point was lost).

This is what Karat saw during a Hercules engagement...

And this is how optical tracking In Dvina looked like and worked: :
they had a fixed TZK telescope, and two wheels, that were connected to the FCO's elevation/azimuth wheel.

Why there's no IADS support in the historical missions?
IADS were not exported at that time (Middle East / Vietnam), even Hungary received the first system in 1980. If the Libyan scenarios will be finished, there will be some available IADS.

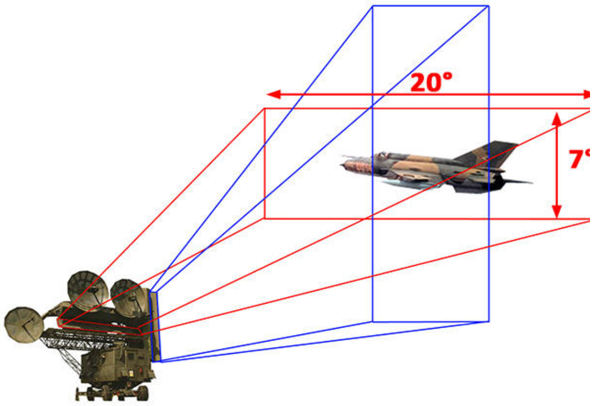
Why H<5 works with wide beam only?
There is a safety switch in the SNR that stops its movement down when it is at zero degreess. When this safety switch is locked, you cannot move it in elevation before you unlock it (page 12, point 4 in the manual).
When your target flies low, it would be annoying to lock the SNR down accidentally, so there is H<5. When you select H<5, your bore-sight is moved down by 3 degrees, electronically (on the elevation [left] display, it is at -3 degreess). So you can safely target low flying targets, you will only lock-down at 3 degreess below ground.
Example: boresight is the line where the system is guiding the missiles.



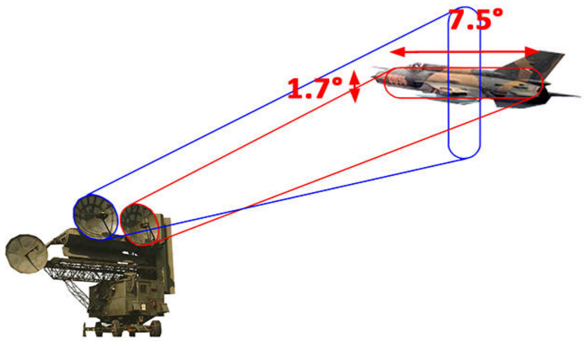
Both screens are for elevation (Epsilon). Left is normal mode, right is H<5.

On the right side, with H<5, the boresight of the system (where it aims) is moved 3 degreess down from the center of the antenna beam.
Now, you can aim at -3 degreess while the system is locked down at 0 degreess in elevation, and also the clutter is less in the Azimuth screen.

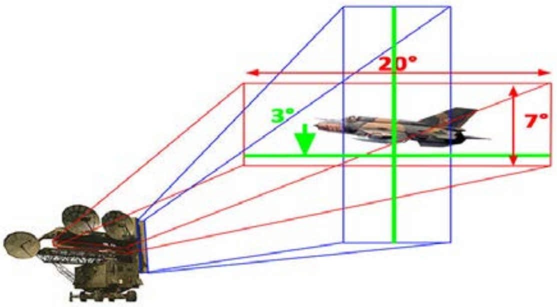
This mode can only be used with the 20-degrees wide beam antenna.
With Narrow beam and LORO antennas, you cannot sink the bore-sight by 3 degreess down electronically, as they are only 1,7 degreess narrow.



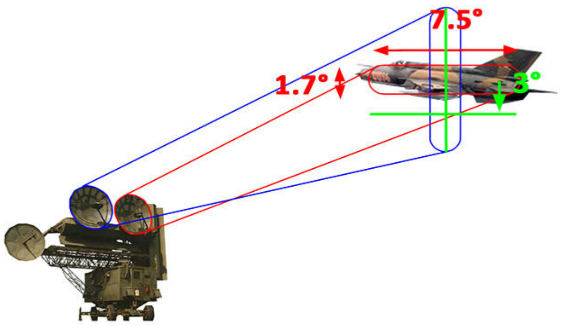
During **Wide Beam** scanning, in the Beta screen (azimuth) you scan 20 degrees in azimuth, and 7 degrees in elevation.



By switching to the **Narrow Beam** antennas, you limit your coverage into 7,5 degrees in azimuth, and 1,7 degrees in elevation.



By switching **H<5 mode**, you move the elevation boresight down by 3 degreess.



In the **Narrow Beam** case, combined with **H<5**, you would simply move the boresight **OUT OF THE COVERAGE OF THE AZIMUTH BEAM**, and lose your target.

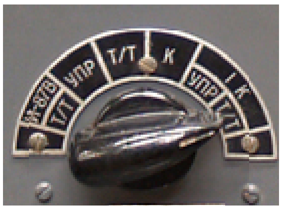
Why narrow beam shouldn't be used to guide the missiles?
The **Wide Beam** (SIROKIY LUCH) mode is inherited from the Dvina.
It uses the two wide beam antennas (P11V, P12V) to send and receive both target and missile channels. It guides the missiles to the boresight of the wide beam antenna system (same point where the target is).
The **Narrow Beam** (UZKIY LUCH) mode is using the two parabolic antenna (P13V, P14V) for emitting the 1MW microwave energy towards the target, and receiving it. As those antennas are much more focused, with the same emitter output, you achieve 3x times microwave power density. This results a bigger detection range. (Originally developed against the U2/SR71 "dirty bird" coating)
The big problem is that the beam emitted by the P13V/P14V antennas are too narrow for the missile tracking. The missiles would simply slip out, and would be lost.
So the missile beacons are tracked by the wide beam (P11V/P12V) antennas.
BIG-BIG problem is the alignment of the boresights of these two independent antenna systems. The target is followed by one (P13V/P14V) system, and the missiles are tracked by the other (P11V/P12V). If these two independent antenna systems bore sights is misaligned by a fraction of a degrees, the missiles would simply miss the target.
So another mode was developed... the **LORO** (PODSVET) mode, as the mix of the two modes discussed above. It uses the narrow beam (P13V/P14V) antennas only to illuminate the target (send out focused microwave energy). The signal reflected from the target and the missile beacons are received by the wide beam (P11V/P12V) antennas. Thus the guidance circuit is guiding on the wide beam antenna boresight, and the target/missiles meet at the same place.

***Cet obscur objet du desir*, or V-760 (Nuclear Volkhov)**

To launch a V-760:

1) select V-760 for your scenario (in such case, you will have no other missiles available);
2) proceed with the preparation like for all other Volkhov missiles;
3) rotate the fuse selector switch all the way to the right (NC-USU);

4) select one of the two rightmost guidance methods:



Note that you have option of either UPR (lead) or T/T method, such as for conventional missiles.
If these switches are set correctly, the red K3 lamps for three missile channels on Z screen, indicating “detonate by radio command”, should burn, irrespective of their switch position.
Here you go, nuke’em!

When missile detonates I don't see any detonation at all... How should nuclear blast look like?
You don’t see the detonation because nuclear fireball absorbs – and doesn’t reflect - radio waves. In turn, you can always hear the **BIG Nuclear BANG**, just wait for its sound to arrive. Your missiles are travelling with Mach2~3, while the BANG never achieves more than Mach 1. To hear a nuclear detonation at 25km, you need to wait more than a minute after the explosion...
Ah, nuclear explosion will take out your missiles in flight too.

Will I survive this?
The Russians considered 6km as safety distance for the V-760 (15kt) missile. It means that over 6 km from explosion point, even window glass should not break. This was also the minimum altitude for V-760 use to be considered safe for surface objects underneath.

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